

STORAGE ARRANGEMENT FOR A SALAD WORK TABLE

by

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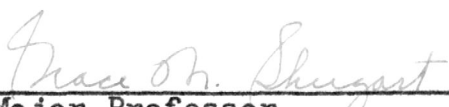
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## INTRODUCTION

Design and organization of the kitchen are important aspects of architectural planning and have been major concerns of food service managers and family economists. Research in industry and in educational institutions has been directed toward aesthetic and functional design of facilities, arrangement of equipment and working space to control and simplify the motions of the worker. Flow of work and equipment, movement of worker, organization and arrangement of centers, design of equipment and utilities, space allowances for work areas and equipment, and relation of height of worker to the work area were some of the major considerations in these studies.

Recognizing the important relationship between man-machine and the workplace, industrial engineers have focused their attention on ways and means of reducing unnecessary effort in work through energy-saving methods of performing industrial tasks.

Organization of work centers, with large equipment in the kitchen arranged to produce optimum efficiency in work performance, is one approach to saving time and energy. Another that has not been explored entirely is the systematic investigation of storage requirements for supplies and small kitchen utility items needed for specific areas. This aspect, which is equally as important as the efficient arrangement of work centers and major equipment in the kitchen, often is given

little consideration by planners. Research is needed to provide information on essential tools and supplies and required storage space for architects and equipment manufacturers. A salad work table would be a typical example.

A variety of tables with different specifications have been designed, constructed, and are in use in institutional kitchens. Most of them are of standard size and design and can be used in any area in the kitchen. They lack functional storage space to accomodate the supplies and equipment used for that particular center. Little consideration, if any, has been given to the job to be done and the number and various types of equipment that have to be stored. Generally, the available space and its location determine the use and amount of material to be stored and not the way the storage would be used. Thus the obvious case here is, function following form and not form following function. As a result people in the food service industry encounter many problems that are related to inadequate space at the appropriate places, storage poorly designed for the articles to be accomodated, and waste of space within the storage units. Shelves or drawers are either set too far apart or are too shallow or too deep for specific items. Inadequate or inefficient storage space, not uncommon in otherwise well-designed kitchens, has resulted in inconvenience and extra handling of items. This causes time waste and unnecessary movement for the busy worker.

The purpose of this research was to determine two ways of locating and organizing the storage space for a salad work table to be used by one employee for a 200-250 student dining hall; and to compare the two arrangements with one in actual use in a residence hall that serves approximately 200-250 students.

## REVIEW OF LITERATURE

Research on kitchen arrangement including the selection and location of major equipment, designs for work centers, and space allocation for storage of utensils and supplies in the areas of their use was begun in the early 1900's. Few studies, however, actually have dealt with the storage requirements of specific work areas in the home or in the institutional kitchen. Therefore, review of literature pertaining to research in the general area of home kitchen storage and principles developed for arrangement of the storage areas would be of relevance. These principles are fundamental in nature and could be applied to the organization of specific work areas in the institutional kitchen, which is the concern of this study.

### Functional Storage

Functional storage, as defined by Heiner et al. (1948) is "adaptation of form to use". The prime consideration of functional storage is to avoid unnecessary movement and to

provide better visibility of the items stored. Similarity of form, which is the main criterion in grouping objects in traditional storage, is disregarded. These authors recommended increasing functional storage through:

1. Planning storage space for supplies in active use within a woman's maximum reach from shoulder to grasping fingertips.

2. Providing space for the most frequently used supplies within the radius of the elbow to grasping fingertip reach.

3. Planning narrow shelves and shallow drawers to provide for ease of grasp and increased visibility. This means storage in one row or one layer deep and one stack high.

4. Planning storage at the sink, the range, and the mix areas of first use, to replace traditional concentration of supplies by similarity of form of content without regard to use.

5. Providing cut-out front areas for wide shelves on older cabinets if some supplies require a greater depth than do others.

6. Providing shallow front-to rear major equipment and counter space consistent with a woman's reach and ease of vision.

Steidl et al. (1968) listed three principles that provide basic directives for functional storage:

- Principle 1. Store frequently used items at place of first use.

This principle requires an analysis of the job to be done at a particular work center by determining the items that are to be used for the job and the frequency of their use. The function to be performed at the center determines the equipment that should be readily available. An inventory of the items needed serves as a guide in planning for the required amount of storage space and its physical characteristics.

Storage of items at place of first use means less work on the part of the employee. Consequently this eliminates the unnecessary search and saves the extra effort and time spent in walking to a storage space to get the items.

Principle 2. Place items so they are easy to see, reach, grasp, and replace.

Application of this principle means better organization resulting in greater ease of work and less physical effort, time, and dissatisfaction. This can be achieved through grouping of items serving a similar function, positioning items for use, keeping parts of a piece of equipment together when the parts must be assembled before any use, and allowing sufficient margins around items stored.

Principle 3. Determine the worker's limit of reach.

This principle relates to the physical requirement of the worker with respect to her reach, height of work surface, design of storage, and location of items. It is directed toward efficient work with minimum discomfort by allowing the

person to maintain a comfortable posture while working.

Aspects to be considered in the physical design of workplaces were identified by Steidl et al. (1968) as:

1. Location in vertical space

- Height of work surfaces

- Height of shelves, drawers, bins

- Height of appliances or their parts

- Weight and size of items to be stored

2. Location in horizontal space

- Supplies, tools

- Adjacent workplaces--height

3. Spatial arrangement of parts

- Work surface-appliance relationship

- Distribution of work surface

- Location of drawers, doors, bins

- Location of controls

4. Amount, dimension, and space for

- Work (length and width of surface; depth of basin)

- Worker at work--one and more than one

- Storage of supplies and other items

5. Provision of special features

- Utilities (electricity, gas, water, drainage)

- Duplication of facilities

- Ventilation

- Lighting



## Storage Arrangement

Wilson (1933) used the criterion of space economy in determining dimensions for storage space of equipment and supplies and providing various activities in the kitchen. Plans of sink center, mix center, and supplies and equipment were used to illustrate arrangement of the respective areas. A list of dimensions included margins around articles stored, distance between counter and first shelf of upper cabinets, length of counter, and maximum height of storage from floor to shelf.

In another study, Wilson (1939) developed a guide to determine equipment, arrangement, and minimum kitchen dimensions that would provide adequately for the needs of farm families. She suggested a desirable procedure in planning the kitchen, the floor area and wall space required for each center, the minimum and average dimensions for storage and work space, and step-saving routing of activities.

Edwards (1940) suggested space allowances and plans for closets and other storage arrangements in farm homes. Among her recommendations were: china, glasses and other dishes should be stored directly above the surface of the drain-board; vertical compartments should be used for storing platters, large plates or small trays; and drawers to store small utensils, cutlery, staples, and saucepans should be directly below the surface of the right end of the sink. She further added

that shelves above and below the work surface should be adjustable, as space is wasted when shelves are too far apart.

Heiner and McCullough (1948) took the first step toward a study of functional kitchen design in terms of the housewife, who is the user. Different cabinet designs for major work centers, based on the storage requirements of present day inventories, were presented. Three problems were studied: adequacy of storage for packaged supplies; storage of utensils and tools; storage of china, glassware, and other accessories to table setting. The authors pointed out the need for more functional shelf-depth and height and for more readily accessible arrangements within the cabinets than was available in the market.

Wilson (1947a,b) recommended kitchen cabinet designs based on economy of space, labor, simplicity, ease of construction, low cost, and durability. Kitchen organization and management, storage requirements of articles and clearances around them, use of standards for storage, and standardization of kitchen cabinet patterns were emphasized. She also recommended dimensions for depth, width, and height of work surfaces; number and placement of shelves; and length of shelving needed for specific uses.

Steidl (1958) reported principles for reducing the workload in the home kitchen through better arrangement of work centers, design of storage facilities, and duplication of equipment. In a later study (1961), she recommended the use

of adjustable shelves, door racks, pull-out panels for hanging items, and vertical dividers to improve storage conditions. By making storage more functional items are selected, grasped for use, and replaced without extra handling; thus the work would progress without interruption.

A study of storage requirements for various kinds of household articles by McCullough (1952) resulted in quantitative space requirements of various articles used, their arrangement, and suitable location, also use of storage space in the kitchen. Such information would be helpful to architects and others interested in planning, designing, and house building.

General design of storage space, location of the inventory, facilities used, and design of devices to improve storage were some of the management aspects considered in a study by Mize, Heiner and Warren (1953). Evaluation of the adequacy of storage organization was directed toward determining the effect of design and arrangement of storage space on the working load of the homemaker.

Cowles et al. (1958) studied the savings in distance walked through the reorganization of storage of materials, tools, and movable equipment in 56 rural kitchens. The reorganization did not involve changes of the arrangement of the furniture and major pieces of equipment, such as sink, range, and cupboard. Results showed considerable savings in the amount of distance traveled through reorganization.

Analysis of the types of changes made in the relocation of the kitchen showed that more than half (55.6%) of the separate items of food and pieces of equipment needed some change in location. Items most frequently in need of relocation were measuring cups, spoons, saucepans, various types of knives, stirring spoons, serving bowls, and platters. The authors concluded that the organization of supplies and equipment in the various centers is extremely important.

A "lazy susan" type salad assembly table (Kannan, 1961) designed by U.S.D.A. Agricultural Marketing Service researchers was tested in a Topeka, Kansas Cafeteria. The table consisted of top and lower decks that rotate. The top is equipped with an ice bed for storage of ingredients needed to make the salads. The bottom and larger deck is for salad assembly. Trial use of this table resulted in increased productivity, fresher salads (because they were made closer to time of sale), less operator fatigue, and more easily accessible ingredients. However, it is a specialized piece of equipment and has limited storage space for supplies. More floor space is needed than for conventional type tables.

### Storage Guides

Improperly planned work area in terms of available storage space is a problem often encountered in the food service industry.

Location of equipment within easy reach of the worker influences the efficiency of work (Esch, 1962). Steidl (1968) added that availability of needed facilities, items, and space help the worker to perform her job without breaking the rhythm of productive activities.

Wilson (1947a) pointed out seven major considerations in planning storage space: (1) convenience for the worker, (2) care of articles stored, (3) space economy, (4) flexibility in use, (5) appearance of room, (6) ease of keeping clean and in order, and (7) cost. These considerations determine choice of type of storage facilities as drawers or shelves, utilization of space within the drawers or on the shelf, and location of these facilities in relation to the work surface. She also recommended the following procedure for planning storage cabinets:

1. List items to be stored.
2. Group them according to the work surface where they will be used most frequently.
3. Group articles in each work center with respect to similarity in storage requirements.
4. Determine unit dimensions for each group of articles stored and margins for hand action in placing and removing them.
5. Assign each group to a specific part of the space below, above, or adjacent to the work surface.

6. Determine the total space required for each group of articles.

7. Formulate detailed plans for each part of the storage space, making such adjustments in assignments as are needed for the best use of space.

Additional suggestions for planning and use of storage were:

1. Group articles stored as to (a) place of use, (b) frequency of use, (c) weight, (d) height, and (e) whether vision is needed for placement or removal.

2. Assign space in cabinets so that the articles most frequently used are easiest to reach.

3. Store heavy articles at or below the level of the work surface where used.

Based on her study of time spent for meal preparation and clean up in the home kitchen, Steidl (1958) recommended the organization of most storage centers at places of first use rather than last use. Her findings showed that greater time is consumed and greater pressure is felt by the homemaker during meal preparation compared to clean up thus, storage at place of first use is favored.

Depth of Work Surface. Minimum dimension for a work surface should be based on the counter space required for the convenient assembly of tools and supplies in connection with the work done there and the width of the space required by the worker (Wilson, 1947a). Wilson found that the depth of 24 to

27 inches would permit a worker sufficient space to assemble supplies and small equipment in a semicircle; and if no assembly is required the work surface could be reduced to 16 inches.

Clearance Around Articles Stored. According to Wilson (1947a) and reaffirmed by Mize (1952) a minimum clearance of 1 inch over an object is adequate for ease of its removal and replacement. If the items are held firmly in place a margin of  $\frac{1}{2}$  inch is sufficient.

For articles that are hanging when stored, she recommended a minimum distance of  $1\frac{1}{2}$  inches between the upper or lower tip of the utensil handle and another utensil or the shelf above it.

Height of Shelves. McCracken et al. (1959) found that the most satisfactory height for storing items frequently used and those requiring both hands for placement and removal was between 28 and 52 inches. For the storage of less frequently used and lightweight objects, she recommended that the shelves may be between 20 and 28 inches high or at a height of 52 and 60 inches above the floor. Shelves outside these limits should be utilized for storing articles seldom needed. Mize (1952), judging from the criteria of angle of bend and energy index, concluded that the space easiest to use was between 27 and 63 inches above the floor.

## Evaluating Work

Studies of physical work have been conducted in which the rate of energy expended was measured in terms of "physiological cost." This measurement has served as the basis for evaluating work methods, work content, and design and arrangement of work place and equipment.

"Physiological cost" can be measured by a number of methods. Indirect calorimetry has been employed to investigate the amount of energy a woman expends in the performance of various household tasks (Bratton, 1951; Swartz, 1933). Such home-making activities included: carrying loads (Orsini et al., 1951), vacuum cleaning (Swartz, 1929), laundering (McCracken et al., 1960), ironing (Knowles, 1944) and bedmaking (Elliot et al., 1963; Singer, 1960).

A series of studies have been made by home economics research workers at the Ohio Agricultural Experiment Station to evaluate the relationship of energy expenditure and posture to methods of work, design of equipment, and space. Techniques used in the energy expenditure studies were reported in a manual (Elliot et al., 1963).

McCracken and Richardson (1959) also used indirect calorimetry by oxygen consumption to determine the most satisfactory heights for the storage of household articles and to compare the different design of storage facilities; and in another study in 1966, to establish a criteria for the



arrangement and working heights of home laundry areas.

Lehman (1957) reported three methods used in the measurement of work-load in industry. One method was the measurement of the energy cost of work using a respiration-gas-meter.

Physiological cost also has been investigated from the standpoint of increased heart rate. This method, according to Brouha (1967), seemed to be the most direct, simple, and often the only available method for evaluating stress "on the job." Stress produced by muscular activity can be determined by heart rate obtained under conditions that give the subject freedom of activity. The motion study principle relating to simultaneous and symmetrical use of the hands has been studied by this method (Nichols et al., 1959), with a conventional portable -electro-cardio machine and a recording-radio-tachometer as the measuring devices.

Development of telemetering devices permitted the continuous recording of the heart rate of a person at work and it also gave the subjects greater freedom of action than the previous techniques. Holter (1961) reported on the work that was being undertaken to obtain long-period, continuous electrocardiography with the greatest possible freedom of activity for the subject. A step forward was the development of the portable radio-receiver tape recording unit with the semi-automatic method (AVSEP-Audio Visual Superimposed Electrocardiogram Presentation) for the rapid analysis of resulting data. The subject can carry this portable system

any place he wishes to go as long as it is kept in his general environment. The magnetic tape storage in the unit does not require an individual to remain within range of the radio receiving unit and the electrocardiographic observing equipment.

## PROCEDURE

### Development of the Table

When the project was started, specifications of the table, such as its specific dimensions, materials to be used, amount and type of storage facilities and their locations, were in an undefined stage. Only its function was known; that is, the table was to be used as a salad work table for one employee in a residence hall kitchen serving 200-250 students.

Limitations. An experimental table was designed with the following restrictions:

1. All storage space to be located below the table top. Below the table storage was selected to permit maximum work surface.
2. Salad bowls and plates to be stored in dish dollies under the table so that dishes could be transported directly from dishwashing area to point of use.
3. Routing of activities to be from right to left.
4. Storage facilities for equipment to be located at the right hand side of the table to facilitate right to left flow of work.

5. Storage for small equipment only to be provided. Saucepans, baking pans, mixing bowls, and other larger utensils would not be stored in the table, but in an auxiliary storage space near the table.

Flexibility. Since this table was to be used for experimentation, its construction needed to be flexible so that the size and type of the overall storage space could conveniently be changed, reduced, or increased. Thus, the table was so designed that two types of storage facilities could be installed; that is, a conventional drawer type and a vertical panel type.

Materials. Two supports were considered in planning the table with a plywood top: (1) aluminum slotted angles for legs and drawer supports; and (2) wooden legs and drawer supports. The use of slotted angles had the following advantages:

1. Could be readjusted in a short period of time.
2. Easy to dismantle and store when not in use.
3. Precision made as all the parts are mass produced.
4. Low in labor cost.

The wooden legs and supports for drawers had the following advantages:

1. Light in weight.
2. Low material investment.

Although slotted angles had more advantages than wood for legs and supports, the latter actually was used. Materials

available locally did not meet the required specifications and would have to be ordered, which meant loss of time and unnecessary delay of the project. The table was made by the Kansas State University Physical Plant, according to specifications and sketch in Figure 1.

General Dimensions. Dimensions of the table are: length, 84 in., width, 25 in., and height, 36 in.

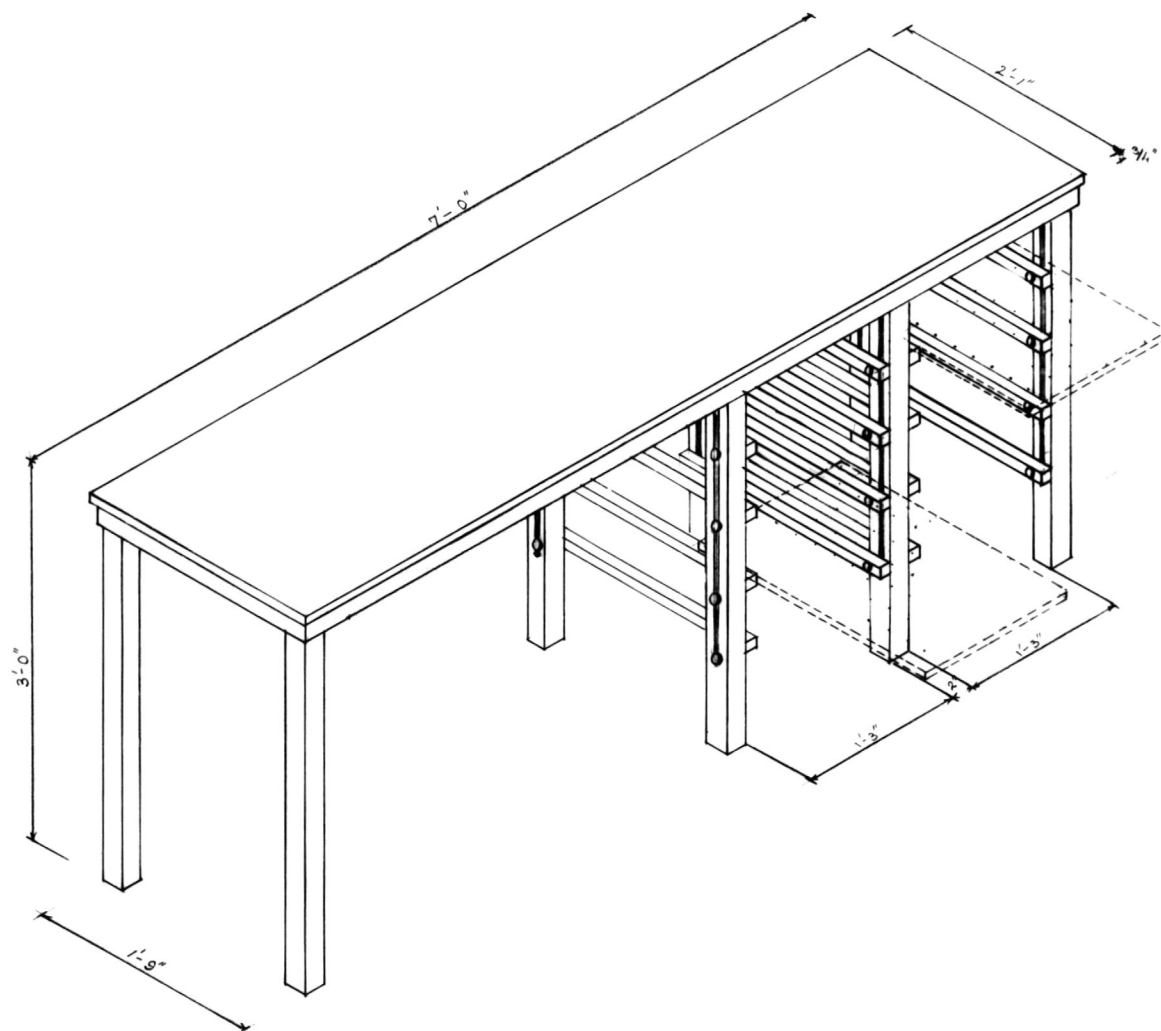
The following factors were considered in determining length and width of the table:

1. Adequate work surface for one worker.
2. Convenient reach of the worker.
3. Adequate storage space under the table for two dish dollies and for storage of inventory.

The height of the table was 36 in., the same as the tables manufactured by Southern Equipment Co. for the Quantity Foods Laboratory, Department of Institutional Management.

The table had eight legs instead of the conventional four to provide for flexibility of arrangement. The additional four legs were provided on the right hand side as shown in Figure 1 to support 1" X 1" horizontal runners on which to slide drawers used or to support two boxes holding pullout vertical panels.

A  $\frac{1}{2}$  inch groove approximately 2 feet in length was provided in six legs so that runners could be moved up or down according to drawers depth desired. Runners were fastened to the legs with bolts and butterfly nuts.



## S A L A D   W O R K   T A B L E

Figure 1. Sketch and specifications of salad work table.

Storage Facilities. Two types of storage facilities were installed on the table:

Arrangement A. This was a drawer type storage facility using  $\frac{1}{4}$  inch thick pegboard resting on horizontal runners fastened to the legs of the table. The equipment was clipped to the boards to avoid its movement when sliding the drawers (Figure 2).

Arrangement B. This arrangement involved the use of vertical panels which were made of the same materials as that used in arrangement A. Two boxes 20" by 18" by 24" with  $\frac{1}{2}$  inch deep grooves in top and bottom walls, with ends open and supported on two runners were used to hold the vertical pullout panels. Distance between the grooves was determined by the dimension of the equipment that hung from the panels (Figure 3).

Holding Devices. Metal clips and hooks available at the local hardware stores and lumber yards were used to hold the equipment in place. These clips are manufactured for display purposes in commercial stores and for domestic storage. For actual use in an institutional kitchen, however, the holding devices should be individually designed for each piece of equipment.

#### Arrangement of Equipment

Formulation of Basic Utensil List. No study was available to draw upon in formulating a basic list of utensils that

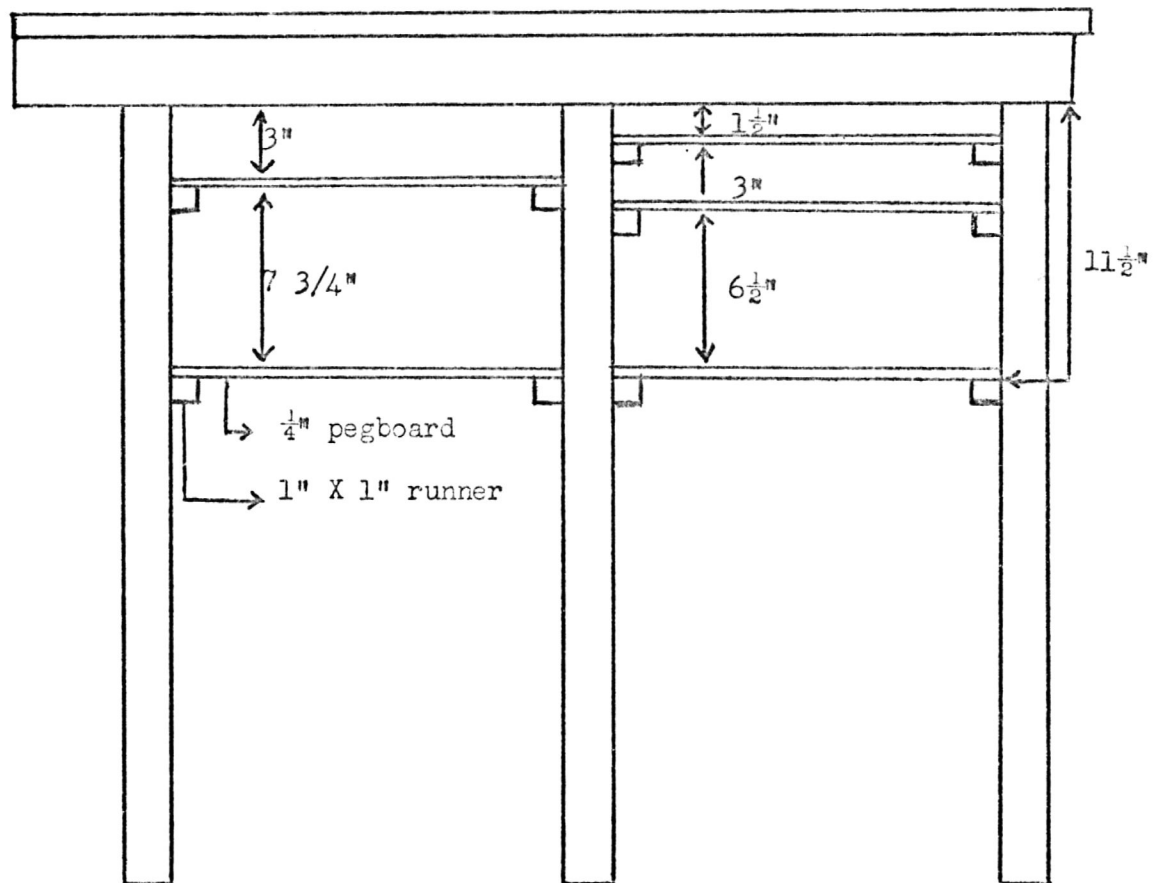


Figure 2. Arrangement A

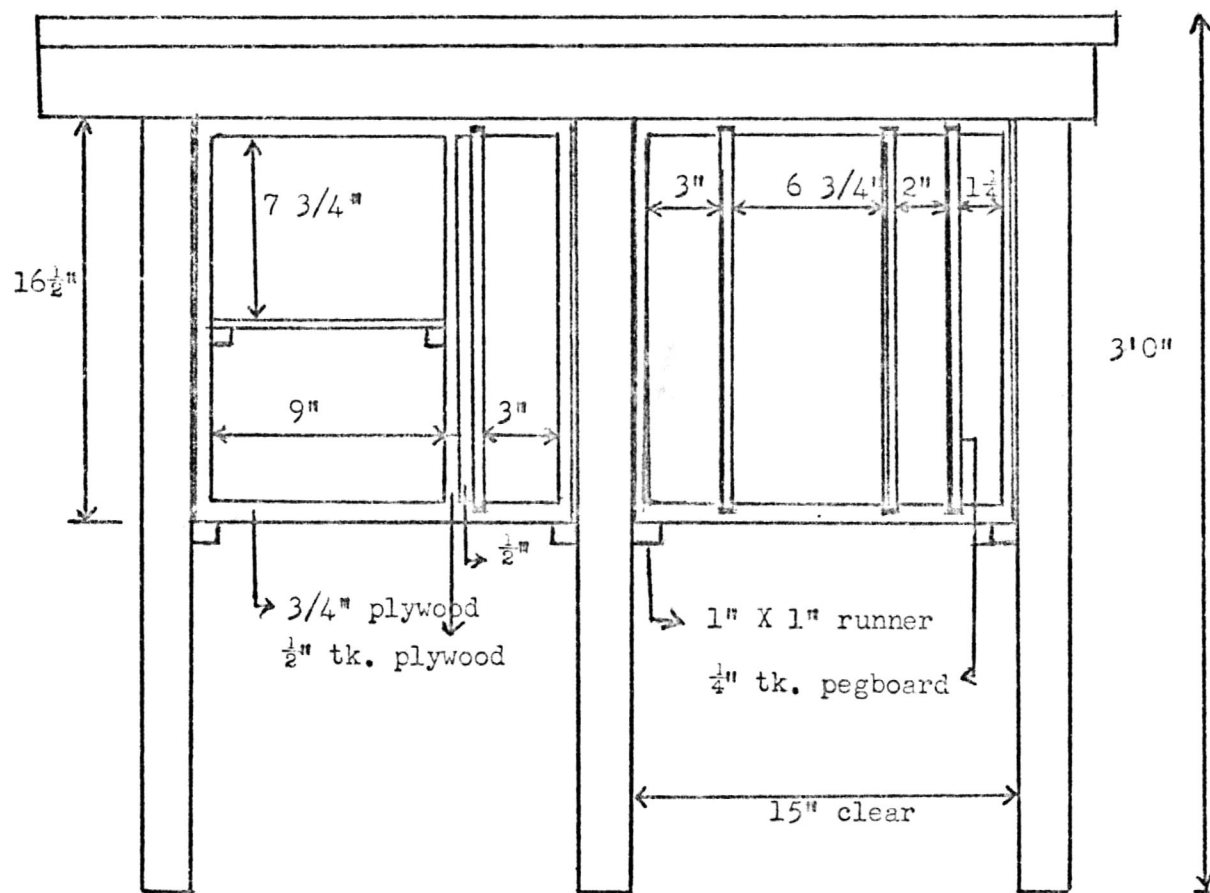


Figure 3. Arrangement B



normally would be stored in a salad work table. The inventory of equipment (Table 1) used in this study was adapted from such sources as textbooks, inventory of equipment in a small residence hall at Kansas State University, and suggestions by staff members of the Department of Institutional Management.

Assigned Location of Utensils for Storage. Principles of motion economy were applied to assignment of storage articles to specific locations. After preliminary work, readjustments were made in these locations based on opinions expressed by workers and on observations made by the investigator. Distribution of equipment to drawers (arrangement A), and panels (arrangement B) follows:

Arrangement A

Set of drawers (right side)

Drawer 1 (top) depth-  $1\frac{1}{2}$  in.

cutting board

Drawer 2 (middle) depth- 3 in.

knives

serving spoons, solid

serving spoons, perforated

potato peeler

knife sharpener

wire whip

Table 1. Utensils used in a salad work table

No.	Name of Utensil	Dimension
		Length X Width X Height
2	Serving spoons, solid (S/S)	11½ X 2½ X 2
2	Serving spoons, perforated (S/S)	11½ X 2½ X 2
1	Spatula, rubber, large	13 ¾ overall length
1	Spatula, rubber, small	
1	Spatula, (S/S)	1½" blade, 12 overall L.
1	Turner, small (S/S)	
1	Potato peeler, floating blade	6½" overall length
1	Set of 5 knives	14 1/8", 11 ¾", 10" 8 ¾", and 6 ¾" overall length
1	Set of 4 measuring cups, aluminum	
6	Scoops, nos. 10, 12, 16, 24, 30, and 100	
1	Set of 4 measuring spoons	
1	1-qt. measuring cup	
1	Egg slicer	
1	Grater	4" X 3" X 9"
1	Wire whip	14" length, 2 ¾" ht.
1	Dough divider (6 wheels)	
1	Cutting board	12" X 18" X 1"
1	Colander	5 ¾" high, 12" overall
1	Can opener, electric-table model	
1	Strainer, small	

Table 1. (Contd.)

No.	Name of Utensil	Dimension
		Length X Width X Height
1	Knife sharpener, steel	
20-30	Trays, aluminum	18" X 25" X 1"
200	Salad bowls	5½" diameter
200	Salad plates	6" diameter
1	Dish dolly for plates	31 7/8" X 18½" X 18½"
		Dish size- 6" to 6 3/4"
		200 capacity
1	Dish dolly for bowls	31 7/8" X 18 1/8" X 19 1/8"
		Dish size- up to 5½"
		400 capacity

Drawer 3 (bottom) depth-  $6\frac{1}{2}$  in.

measuring cups

egg slicer

strainer

colander

grater

Set of drawers (left side)

Drawer 1 (top) depth- 3 in.

scoops

turner

spatula

dough divider

Drawer 2 (bottom) depth-  $7\frac{1}{2}$  in.

box of plastic gloves

waxed paper

opened box of gelatin

### Arrangement B

Box 1 (right side)

first panel (right) width-  $1\frac{1}{2}$  in.

knives

potato peeler

knife sharpener

serving spoons

second panel (center) width- 3 in.

Measuring cups

colander

third panel (left) width- 6 3/4 in.

spatula

turner

eggslicer

strainer

wire whip

grater

Box 2 (left side)

first panel (right) width- 3 in.

scoops

dough divider

upper drawer (depth- ) 7 3/4 in.

waxed paper

plastic gloves

lower drawer (depth- ) 7 3/4 in.

opened boxes of gelatin

#### Development of Standardized Procedure for Salads

Three types of salads (tossed, gelatin, and pineapple with cottage cheese) were selected for the laboratory procedure. Criterion for selection of these salads was that their preparation would involve the use of different processes typical at a salad table, equipment, materials and of storage space.

### EXPLANATION OF PLATE III

Top photograph shows arrangement A with equipment. This is a drawer type storage facility using  $\frac{1}{2}$  in. thick pegboard resting on horizontal runners fastened to the legs of the table. The equipment was clipped to the boards, to avoid its movement when sliding the drawers. Bottom photograph shows the first drawer with cutting board.

## PLATE III



EXPLANATION OF PLATE IV

Photographs show second and third drawers  
(right side) respectively in arrangement A.



PLATE IV



#### EXPLANATION OF PLATE V

Top photograph shows first drawer (left side), arrangement A. Bottom photograph shows second drawer (left side). This drawer is for the storage of boxes of plastic gloves, waxed paper, opened boxes of gelatin, and salt.

PLATE V



#### EXPLANATION OF PLATE VI

Top photograph shows arrangement B installed on the table. This arrangement involved the use of vertical panels. Two boxes 20" X 18" X 24 ", with  $\frac{1}{2}$  inch grooves in top and bottom walls, with ends open and supported on two runners were used to hold pullout panels. Left side of photograph shows one of the dish dollies for storage of salad bowls and plates. Second panel of first box is shown in the bottom photograph.

PLATE VI



#### EXPLANATION OF PLATE VII

Top and bottom photographs show third  
and fourth panels (first box) respectively  
in B arrangement.

## PLATE VII



#### EXPLANATION OF PLATE VIII

First panel (second box) is shown in top photograph. Bottom photograph shows the drawer for storage of boxes of plastic gloves, waxed paper, opened boxes of gelatin.



PLATE VIII



A standardized procedure was developed for preparing each of the three salads (Appendix A). Six basic principles of time and motion economy that were applicable to food preparation were applied in determining the salad preparation methods (Barnes, 1964). They were:

1. Both hands should be used whenever possible.
2. Continuous curved motions are preferable to straight line motions involving sudden and sharp changes in direction.
3. Motions should involve the least amount of body movements possible.
4. Definite and fixed stations should be provided for all tools and materials.
5. Equipment, tools, and materials should be located around the work area or position as close in front of the worker as possible.
6. Equipment, materials, and tools should be located to permit the best sequence of movements or a logical work flow.

The procedure was checked with the "Program for Making Dipped Salad" developed by the Work Instruction Program For The Food Service at Kansas State University Department of Institutional Management.

Preliminary work was conducted, with the help of an undergraduate student in Dietetics and Institutional Management, to refine the method and to check the needed readjustments in the assigned location of equipment.

The following assumptions were made in establishing the laboratory procedure for this study:

1. One bun pan would be used for the preparation of each salad. Since only 12 salad plates and/or bowls could be accomodated on a pan, the salads were prepared in a quantity for 12 servings.

2. The subjects would be right-handed and would prefer a right to left routing of work.

3. Since the main consideration of this study was the storage space arrangement of a salad table, the relationship of the table to other storage areas and equipment such as the refrigerator, sink and stove would not be taken into consideration.

4. Activities that involved the use of the stove and sink would not be included.

5. Water for making the gelatin salad would be pre-positioned (in a 2 quart container) on the table. The gelatin mixture prepared by the subject during the experiment would be set aside and heated after the experiment by the investigator.

6. Gelatin salad would be pre-molded.

7. Other equipment and supplies that would be stored elsewhere such as baking pans, mixing bowls, saucepans, boxes of gelatin, and cans of sliced pineapple would be pre-positioned on a cart. See Plate 1.

EXPLANATION OF PLATE I

Arrangement of work area.



PLATE I

8. All cleaning of vegetables would be done in the preparation area. Lettuce heads, radishes, carrots, and leaf lettuce for liner would be pre-positioned on a cart.

#### Criteria for Effectiveness of Storage

Two criteria were used to evaluate the effectiveness of location and organization of utensil and tool storage in a salad work table: (1) physiological cost as measured by extra heartbeat during work and (2) length of reach from the table top.

Physiological Cost. For determining the extra heartbeats per minute due to work, the following equipment was used in the experiment (Plate II).

1. Telemetering device
2. Transmitter
3. Two electrodes
4. DC power supply (Eico-1064)
5. Stop watch
6. Chair

The heartbeats during rest periods and during work were recorded in a prepared chart (Appendix B) for each subject. The extra heartbeats were determined by the following procedure:

1. Get basal or normal heartbeat rate (defined as the lowest heartbeat rate of the 6 rest periods).

EXPLANATION OF PLATE II

Heartbeat equipment.

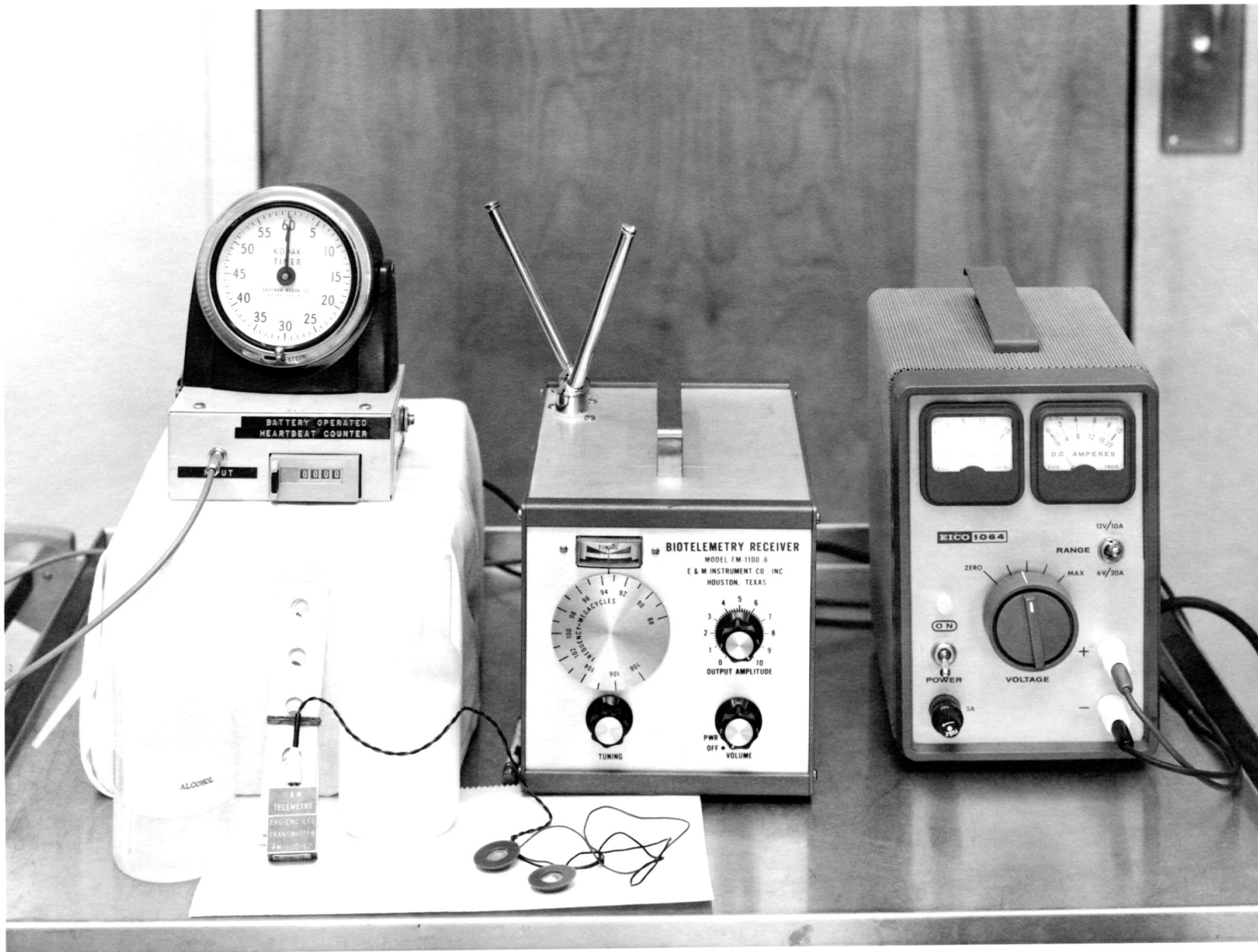


PLATE II



2. Determine total heartbeats during work.
3. Determine total time worked in minutes.
4. Multiply basal beats per minute by time of work to get basal beats.
5. Subtract basal beats from total heartbeats during work to get extra beats.
6. Divide extra beats by total time worked to get extra beats per minute.

Length of Reach. The number and location of reaches to each drawer or panel during the preparation of salads were determined from the standardized procedure. These reaches were counted and recorded in chart form, listing the distance of each drawer or panel from the counter top. To get the total length of reach for each arrangement, the distance was multiplied by the number of times the subject reached to these heights.

Only the reaches made by the subjects to the storage areas of the table were counted, since the location and organization of table storage was the area to be investigated. Reaches between work surfaces, appliances, and other storage areas were excluded.

#### Selection of Subjects

Twelve female students of the College of Home Economics, Kansas State University, were used as subjects. No

restrictions were made on heights, ages, and weights for this study, although it has been established that these factors influence the energy expenditure. Selection of subjects with these restrictions was considered to limit the usefulness of the data to a degree that the results may be applicable only to persons meeting these specifications. Age of the subjects ranged from 18 to 27. Other variables such as food, temperature, and humidity could not be controlled; however, room temperature during each session was recorded on the subject's data sheet. Each subject was previously instructed to wear a dress with a front opening so that electrodes could be attached with ease on the body as shown in Figure 4: also a pocket to hold the transmitter so that any movement relative to the subject could be avoided.

### The Activity

Three salads were prepared by each subject following the determined standardized procedure for each arrangement. One arrangement was done in one session, which lasted approximately one hour. Thus, each subject was called twice. The order in which the subjects did the two arrangements was counterbalanced; that is, six subjects used arrangement A first, and the other six arrangement B. The subjects were assigned to this order according to their availability and the arrangement set-up at that time.

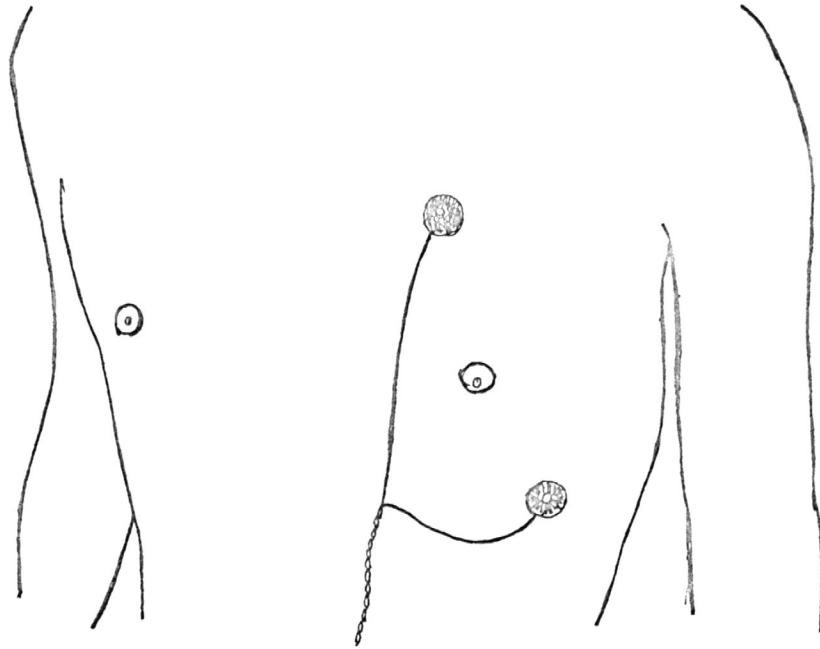


Figure 4. Illustration of placement of electrodes.

## EXPERIMENTAL PROCEDURE

Supplies and equipment were assembled and the testing equipment was set up in the work area before the subjects arrived (Plate I).

During the first session, the subject was instructed verbally as to the purpose of the experiment, the activity to be done, and the routine to be followed during the testing. An outline of the instructions given to each subject during the first session follows:

1. Explain the purpose of the study.
2. Give description of the two arrangements.
3. Explain criteria--physiological cost

--distance reach

4. Ask subject to read the standardized procedure.

State reason for using it.

5. Show the arrangement and location of equipment.

6. Have a trial run of procedure to acquaint subject with the processes, equipment arrangement, and to eliminate variations due to lack of familiarity with the procedure.

7. Ask subject if she has any questions.

8. Inform subject that the investigator would read each step to her as she carries out the experiment, so there is no need to memorize the procedure.

9. Inform subject that the activity would be self-pacing and that time was not considered as a criterion.

10. Mention the opinionnaire to be filled out after each experiment.

Following the initial instruction, the location of the two electrodes on the subject's body was explained. The electrodes were either placed by the subject or by the investigator. The electrodes were then attached to the transmitter and placed in the pocket (if there was no pocket, an improvised pocket was pinned by the investigator to the dress of the subject). The telemetry device was adjusted to the frequency at which the heart beat signal was picked up. The DC power supply was turned on (with the voltage dial for 12 volts) to start the heartbeat counter.

The subject was then instructed to sit down for a 3 minute period to determine the basal or normal heartbeat per minute. At the end of the rest period, the subject began the first task after receiving the signal "Start". As she worked the step-by-step procedure was read to her by the investigator who also recorded the heartbeat count every minute on a prepared chart (Appendix B).

After the completion of each task, the subject was instructed to sit quietly on a chair, while the work table was cleaned and prepared for the next activity.

After each experiment the subject was asked to fill out an opinionnaire to obtain her reactions to the organization of equipment in the arrangement (Appendix C). Another opinionnaire was filled out by the subject after completing the two

arrangements. The second opinionnaire was designed to determine the subjects preference between the two arrangements (Appendix C).

## RESULTS AND DISCUSSION

### Length of Reach

Total distance reach in arrangements A and B was compared with that in the residence hall set up. The number and location of reaches to each drawer or panel holding the equipment used in the three salad preparation was counted. The distance from the table top to the storage location was measured in inches. Table 2 shows the number and length of reaches by height and location for the three arrangements. Total length of reach for the three arrangements were: 48 in., arrangement A; 36 in., arrangement B; and 168 in., residence hall.

The number and location of distance reached in arrangements A and B was approximately the same (A, 8 reaches, 48 in.; B, 9 reaches, 36 in.). Although the length of reaches in both arrangements ranged from 1 in. to 11 in., there was a difference of 12 in. in total distance reached. This could be accounted for by the location of equipment in the two arrangements. The lowest point reached from the table top by the subjects in both arrangements was 11 in. In the A arrangement, the number of reaches to this distance was three, totalling 33 in., and only one in the B arrangement. More reaches were to the

Table 2. Number and length of reaches by height and location.

Distance from table top in.	Reaches					
	A- Drawer		B- Panel		Residence Hall	
	No.	Length in.	No.	Length in.	No.	Length in.
1	1	1	4	4		
2						
3	2	6			9 <sup>a</sup>	31½
4	2	8	1	4		
5			1	5		
6			2	12		
7						
8						
9						
10						
11	3	33	1	11		
17½					1	17½
120 <sup>b</sup>					1	120
Total		48 in.(4 ft.)		36 in.(3 ft.)		168 <sup>c</sup> in.(14 ft.)

<sup>a</sup>Distance from table top is 3½ in.

<sup>b</sup>Distance from base cabinet to cook's table. Distance of pan rack in cook's table from the table top was not counted.

<sup>c</sup>Distance from salad preparation table to base cabinet (35 in.) was not included.

storage area nearest the table top (1 in.) in the B arrangement. Reaches, although more in number, totaled to a shorter length than in the A arrangement.

The great difference in length between the experimental arrangement and that of the residence hall was attributed to the type of storage cabinet used in the residence hall preparation area. The base cabinet utilized for storage of small equipment was not designed specifically for the equipment to be stored in a salad area (Figure 5). The base cabinet was of standard size that could be used in any area in the kitchen. It has shallow drawers and located below the drawers are shelves with sliding doors. The drawers were not deep enough to accomodate all equipment normally stored in the salad area. For example, the 1 qt. measuring cup was too large for the  $3\frac{1}{2}$  in. deep drawers, so it was hung in the pan rack above the cook's table, a distance of 10 ft. from the salad work table. The cutting boards, which also could not be stored in the drawers because of inadequate space, were located in a lower shelf which was  $17\frac{1}{2}$  in. from the table top.

#### Physiological Cost

The Wilcoxon Matched-Pair Signed-Ranked tests (Natrella, 1963) at .05 significance level were used to evaluate differences in heart rate (Table 3).

The average extra heartbeats for all subjects for the two arrangements were: 22.62 with arrangement A, and 20.42 with



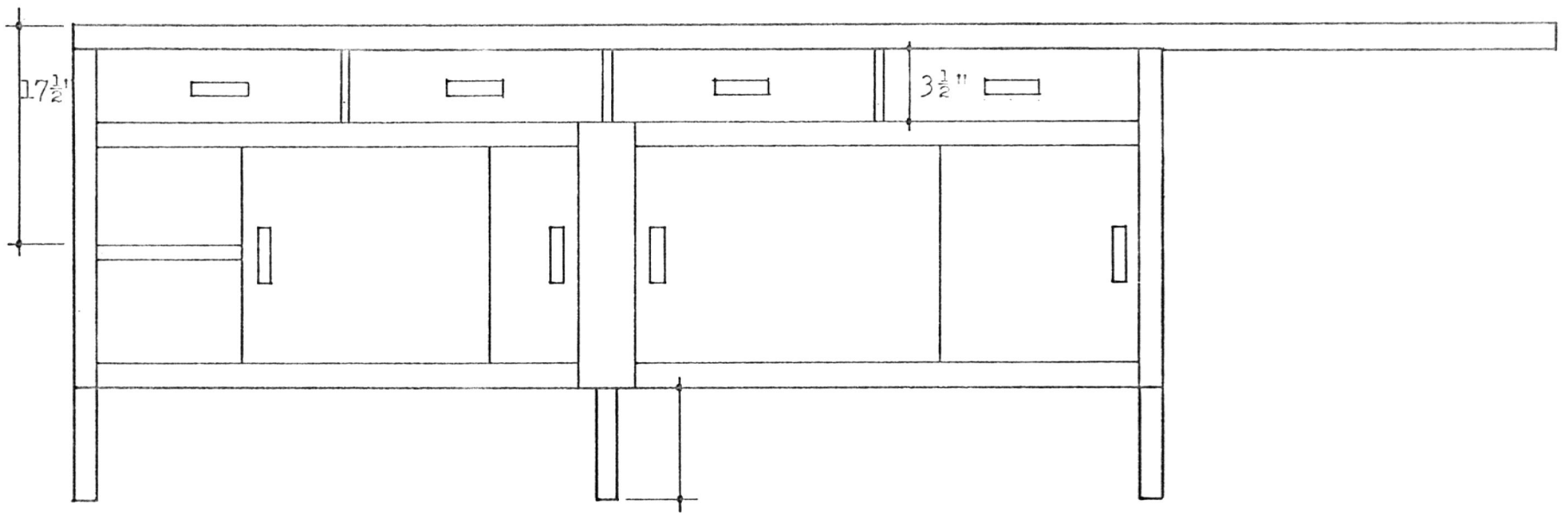


Figure 5 Base cabinet in the residence hall salad area.

Table 3. Extra heartbeats due to work.

Subject	Arrangement A				Arrangement B			
	Type of Salads				Types of Salads			
	1	2	3	Average of 3 types	1	2	3	Average of 3 types
1	21.30	15.75	33.60	23.55	23.02	27.30	27.00	25.77
2	11.00	9.50	6.50	9.00	9.50	7.30	9.00	5.90
3	19.10	20.20	26.25	21.85	14.04	19.10	18.60	17.24
4	14.20	20.00	20.03	18.07	15.02	22.20	20.70	19.36
5	30.00	29.20	34.07	31.00	23.80	37.60	31.04	25.00
6	32.00	9.25	8.65	16.87	4.00	13.30	10.50	9.26
7	27.16	21.82	35.13	28.03	22.16	24.70	35.67	27.51
8	22.66	20.70	21.50	21.62	16.30	22.40	20.10	19.60
9	37.40	29.63	36.80	34.61	21.60	18.20	29.50	23.10
10	37.00	23.70	25.70	28.80	23.40	17.82	21.21	20.81
11	15.50	14.10	16.90	15.50	32.09	25.40	42.50	33.33
12	20.60	16.00	30.80	22.46	16.20	17.90	20.20	18.10
Average	23.99	19.18	30.80	22.61	18.52	17.90	20.20	20.42

1. Gelatin salad

2. Sliced pineapple-cottage cheese salad

3. Tossed salad

arrangement B (Table 3). Arrangement A and B showed no significant difference from each other. This shows that physiological cost of A is not different from B.

From the data obtained in Table 2, one would anticipate the difference in physiological cost between arrangements A and B to be slight. The difference in total length of reach between the two arrangements was only 12 in. In both arrangements, the longest reach was 11 in. from the table top, which is  $21\frac{1}{4}$  in. from the floor. This is within the satisfactory height for storing lightweight objects as found by McCracken et al (1959).

Mechanical difficulty was encountered in obtaining physiological cost in the residence hall, so that this part of the experiment was dropped. Comparison of the two arrangements developed (arrangement A and B) with that in actual use in a residence hall was done with only one criterion--length of reach.

#### Salad Effect

The extra heartbeats for each activity were compared within each arrangement to determine the effect of types of salads. Three conditions were compared: salad 1 versus salad 2, 1 versus 3, and 2 versus 3 within each arrangement. Only one of the six tests was significant; that is, salad 1 (gelatin) versus salad 2 (sliced pineapple and cottage cheese) in arrangement A (drawer). Therefore, it could be

concluded that there is no salad effect within an arrangement.

### Opinionnaire Survey

Responses to an opinionnaire concerning location and organization of equipment in arrangements A and B are summarized in Table 4.

Ten of the twelve subjects expressed preference for B, the panel type arrangement. All subjects thought that articles were well placed in both arrangements. They also indicated that there was enough space provided between articles within the storage areas and enough space allowance between drawers or panels to permit easy handling of articles.

Three subjects suggested the relocation of the colander in arrangement A because of difficulty in taking it out. In both arrangements the colander was located at the far back of the drawer or panel. Unless the drawer or panel was pulled completely out to the front, the upper drawer or adjoining panel partially blocked the colander, making it difficult to remove.

Four subjects found the second and third drawer (right side) in arrangement A too low, but not too low to feel discomfort in removing articles.

Six of the twelve subjects preferred left to right routing of activities. All of them commented that right to left flow

Table 4. Responses to opinionnaire concerning storage organization of equipment in arrangements A and B.

Question	Arrangement			
	A		B	
	yes	no	yes	no
1. After working on the two different arrangements of a salad work table, which arrangement do you prefer?	2		10	
2. Which flow of work do you prefer?				
Right to left - 6				
Left to right - 6				
3. What do you feel about the arrangements of the articles in the drawers or panels? (Is it well arranged?)	12		12	
4. Should some articles located elsewhere?	3	9		12
5. Are the articles--				
a) easy to locate?	12		12	
b) easy to reach?	11	1	12	
c) easy to take out?	11	1	11	1
6. What do you think of the height of the storage area or drawers?				
a) just right for all	8		10	
b) too low for all	4 <sup>a</sup>		2 <sup>a</sup>	
7. Is there sufficient or enough space provided between articles within drawers or panels?	9	3	11	1
8. Is there enough space allowance between drawers to permit easy handling of articles?	11	1	11	1

<sup>a</sup> These subjects considered the height of drawers or panels either just right or too low for some.

of work followed in the experiment did not bother them, however.

Some examples of comments pertaining to organization of equipment in arrangement A are:

Nothing was too low that you have to stoop. Everything was easy to see. Labels indicated where things were.

I liked the arrangement of the articles in the drawers. They seemed easy to locate, except that the measuring cups, knives and spatula could be located nearer the top of the counter.

Everything was in the area of use. It was easy to get and pick up.

The height of the table.

It is convenient and easy to find what you need. It saves steps.

Equipment is easy to see.

Orderly.

The equipment were in a very logical order.

You could see all utensils easily when you pulled the drawer out.

Arrangement of knives seemed inconvenient and some-what oddly spaced.

The height of the drawer with the measuring cup seemed to be low.

Equipment is difficult to grasp.

The things at the back are hard to get to sometimes.

Some of the equipment was difficult to get off the hooks as the measuring cups, but I had no troubles with the others.

Drawers were a little too hard to pull out.

Some examples of comments pertaining to organization of equipment in arrangement B are:

Things are easier to find than the first arrangement. Generally, more space between equipment too.

The articles seemed easier to reach and more convenient.

I liked the ease in preparing the salads. It did not take very long. To me the height of the table and arrangement of equipment were very good.

I liked the height of the table.

It is easy to reach articles.

Very orderly and well planned.

Every articles were easy to reach and could be seen when the panel was pulled out.

It was easy to get utensils. Everything was placed in a logical order.

Enough room to put all utensils in work area.

Everything was easy to get and reach. Also one had to take very few steps. Everything is arranged much better than at home.

I do not like the cutting board at the side.

The articles at the back of the panel are too far back. The panel has to be pulled out a long way.

Seemed to be quite a bit of shifting of pans on top of the table. Could they not be set and remain in one position for entire preparation.

I did not like the position of pans containing carrots, and radishes, lettuce and dish dolly.

#### SUMMARY

A variety of tables with different specifications have been designed, constructed, and are in use in institutional

kitchens. Most of them lack functional storage space to accomodate the supplies and equipment used for a particular area. A salad work table would be a typical example. People in the food service industry encounter many problems that are related to inadequate space at the appropriate places, storage poorly designed for the articles to be accomodated, and waste of space within the storage units. Inefficient storage space has resulted in inconvenience and extra handling of items. This causes time waste and unnecessary movement for the busy worker.

The purpose of this research was to determine two ways of locating and organizing the storage space for a salad work table to be used by one employee for a 200-250 student dining hall.

The focus of the study was on: design of a salad work table and two types of storage facilities for small equipment; formulation of basic utensil list; and standardization of procedure for making three types of salads. The inventory of equipment was stored according to principles of motion economy in two storage facilities: conventional drawer type (arrangement A) and vertical panel type (arrangement B). Conventional drawer type arrangement was a storage facility using  $\frac{1}{4}$  inch thick pegboard resting on horizontal runners fastened to the legs of the table. The equipment was clipped to the boards to avoid its movement when sliding the drawers. Vertical panel type arrangement involved the use of vertical



panels which were made of the same materials as that used in the first arrangement. Two boxes 20" X 18" X 24" with  $\frac{1}{2}$  inch deep grooves in top and bottom walls, with ends open and supported on two runners, were used to hold the vertical pullout panels.

Two criteria were used to evaluate the organization of equipment in the two arrangements: physiological cost as measured by extra heartbeats during work, and length of reach from the table top. The two arrangements developed were compared by length of reach with one in actual use in a residence hall serving 200-250 students.

Twelve students of the College of Home Economics, Kansas State University were used as subjects. The activity consisted of preparing three salads for each arrangement following the determined standardized procedure. An opinionnaire survey was used to obtain subjects' reactions to the organization of equipment in the two arrangements and to determine their preference.

Treatment of data with the Wilcoxon-Matched-Pair-Signed tests showed little effect among salads. Total average extra heartbeats for each subject were: 22.61 for arrangement A, and 20.42 for arrangement B. Comparison of average extra heartbeats for arrangement A and B showed no significant difference in physiological cost.

Total length of reach for arrangement A was 4 ft., for arrangement B, 3 ft., and for residence hall arrangement, 14 ft.

In general, results of the study showed no significant difference between the two arrangements in physiological cost and length of reach. But there was a marked difference in total distance reach between the two arrangements and the residence hall. The great difference was attributed to the type of storage cabinet used in the residence hall salad area. It has drawers which were not deep enough to accomodate all equipment normally stored in the salad area. Some of the equipment, too large to be kept in the drawers, were hung in the rack above the cook's table or located in the lower shelf of the cabinet,  $17\frac{1}{2}$  in. from the table top.

Results of opinionnaire survey showed that ten of twelve subjects preferred arrangement B to A.

#### RECOMMENDATIONS

Further study is needed to reach a conclusion about the adequacy of equipment formulated in this study. Other salads served in the residence hall should be prepared using the experimental table. Procedures other than those followed in this study may be formulated.

Changes suggested by subjects for organization of equipment in the two arrangements could be tested by random selection and preparation of salads served in the residence hall. The criterion of length of reach would be applied in this aspect of the study.

Although there was no significant difference between the

two arrangements in terms of energy expended, ten subjects preferred the panel type arrangement. Some equipment is not adapted to hanging; e.g. egg slicer, dough divider, wire whip, etc. Further study is needed to overcome this problem. Results from this study probably would furnish data to equipment manufacturers concerning equipment design from the standpoint of flexibility and ease of storage. Manufacturers may be able to develop specific devices to hand individual pieces of equipment.

A combination of vertical and horizontal storage is a possibility for future study.

For greater visibility of equipment, the front side of drawers may be left open and a roll out cover extending below the table top to the bottom part of the lowest drawer may be used to cover the storage space when not in use. The panel could be rolled up during salad preparation, so equipment in the drawers could easily be seen.

### ACKNOWLEDGEMENTS

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Sincere thanks to the subjects, without whose cooperation the completion of this research would not have been possible.

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## APPENDIX A



## STANDARDIZED EQUIPMENT AND PROCEDURE FOR MAKING SALAD

1. GELATIN SALAD
2. SLICED PINEAPPLE WITH COTTAGE CHEESE
3. TOSSED SALAD -Lettuce, radish and carrots

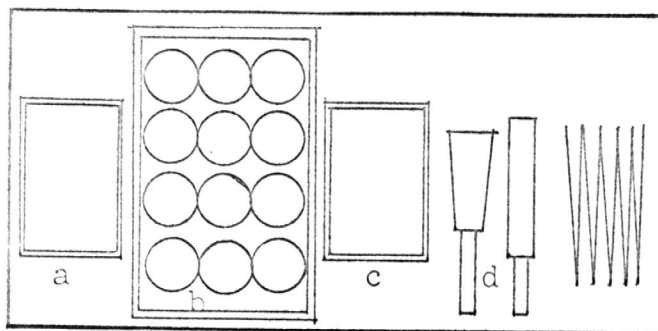
## GELATIN SALAD

## A. Equipment

Serving spoon, solid  
Measuring cups, aluminum (1 qt., 1c and  $\frac{1}{2}$  c)  
Turner, stainless steel  
Dough divider  
Spatula, rubber  
Saucepan

## B. Procedure

1. Get saucepan and 1 lb. box gelatin from the cart and place on the table.
2. Get measuring cups.
3. Get serving spoon.
4. Measure  $1\frac{1}{2}$  qts. water into the saucepan.  
Water is provided in a pitcher pre-positioned on the table.
5. Measure  $1\frac{1}{2}$  cups gelatin into the saucepan.
6. Stir with spoon to dissolve the gelatin.
7. Set aside. Get pre-molded gelatin from the refrigerator and place on the table as shown in the diagram.



- a. pan of lettuce
- b. trays with plates
- c. molded gelatin
- d. turner, spatula and  
dough divider

8. Get 1 tray and place as shown in the diagram.

9. Reach for salad plates. Take 12 plates at a time using both hands. Position the 12 plates at the side of the tray. Pick up 4 plates from the stack and drop one at a time onto tray, starting at the left side, top to bottom. Repeat until all plates have been positioned on the tray (4 plates per row, 12 plates per tray).

10. Get pan of leaf lettuce and position as shown.

11. Line plates with lettuce. Pick up 2 pieces of lettuce using both hands (one in each hand). Place 1 portion of lettuce on each plate, start from left to right, top to bottom.

12. Get dough divider, turner and spatula.

13. Divide pan of molded gelatin into 12 servings (3 X 4) with dough divider.

14. Transfer cut portions of gelatin, using

the turner to transfer the gelatin to the plates and the spatula to position the gelatin on each plate. Start at upper left side. Go from top to bottom.

15. After filling all plates, place filled tray on open rack which has been pre-positioned at the left side of the worker.

#### SLICED PINEAPPLE WITH COTTAGE CHEESE

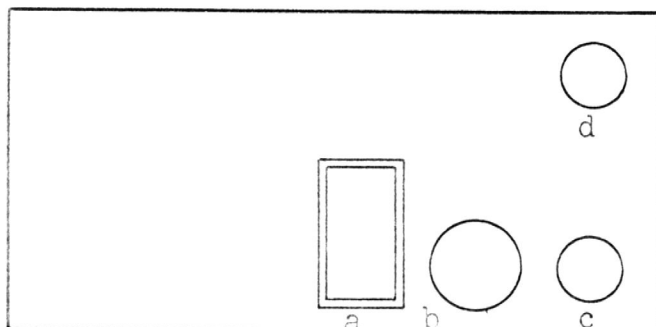
##### A. Equipment

Colander  
Aluminum pan  
Can opener  
Mixing bowl  
Scoop no. 16

##### B. Procedure

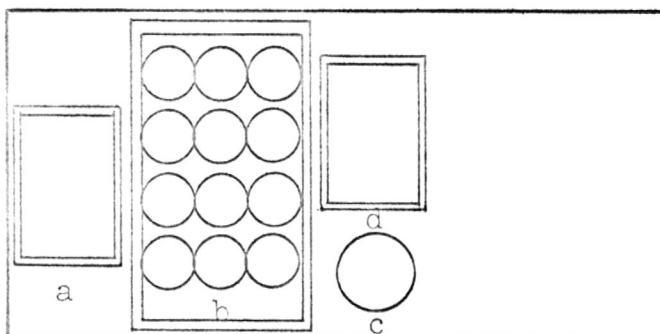
1. Roll cart, on which has been placed canned pineapple, aluminum pan and mixing bowl, to the table at right angles.

2. Position canned pineapple, aluminum pan and mixing bowl on the table as shown.



- a. aluminum pan
- b. mixing bowl and colander
- c. canned pineapple
- d. can opener

3. Get colander and place on top of mixing bowl.
4. Open can, empty into colander to drain.
5. Transfer drained pineapple to the aluminum pan, Position. (See drawing).



- a. pan of lettuce
- b. tray with plates
- c. cottage cheese
- d. sliced pineapple

6. Get tray (Follow step 8 under Procedure for gelatin salad). Position as shown in diagram.
7. Reach for plates (Follow step 9 under Procedure for gelatin salad.)
8. Get pan of lettuce. Position
9. Put on lettuce liner on all plates. Follow step 11 under Procedure for gelatin salad).
10. Get cottage cheese from refrigerator. Position.
11. Reach for box of plastic gloves from the shelf. Put on plastic gloves.
12. Reach for pineapple slices, take 1 slice in each hand. Fill all plates. Start from left to right, top to bottom.

13. Reach for no. 16 scoop.
14. Scoop cottage cheese and put on top of pineapple. Start from left to right, top to bottom.
15. Place filled tray on open rack.

## TOSSED SALAD

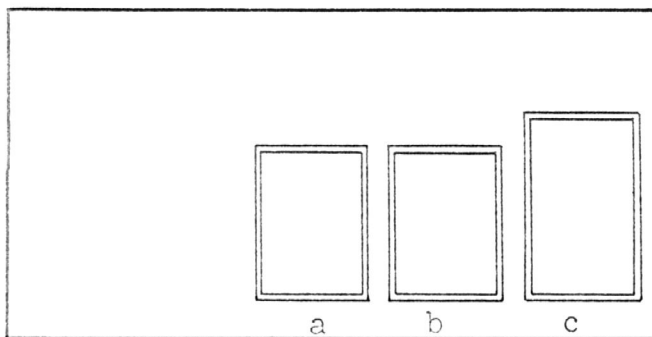
### A. Equipment

Potato peeler  
Knife, 14" long  
Cutting board  
Mixing bowl on dolly

### B. Procedure

Lettuce heads, radishes and carrots, which have been washed in the pre-preparation area, will be on a cart (right end side of the table).

1. Get cutting board and place on the table as shown in the diagram below.



- a. pan of head lettuce  
b. pan of radish and  
carrot  
c. cutting board

2. Transfer pans of radish and carrots (b), lettuce (a) on the table. See diagram.
3. Push the cart and roll the mixing bowl on

dolly to your right as you face the table.

4. Get potato peeler and shred carrots into the mixing bowl.

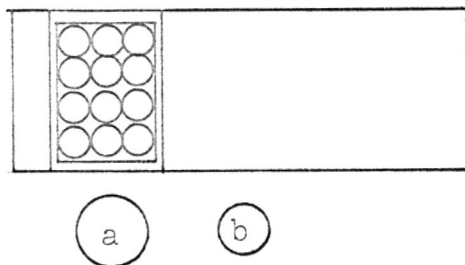
5. Get knife.

6. Transfer all the radishes to the cutting board. Cut all the radishes into slices.

7. Drop from the cutting board into mixing bowl.

8. Reach for 1 head lettuce. Cut into 1" pieces and transfer to mixing bowl. Continue until all lettuce heads are cut.

9. Move mixing bowl to the assembly area. Position as shown.



a. subject

b. mixing bowl with  
tossed salad

10. Get tray. Follow step 8 under Procedure for gelatin salad.

11. Get 12 salad bowls. Follow step 9 under Procedure for gelatin salad.

12. Reach for plastic gloves. Put on.

13. Toss Salad (10 strokes).

14. Transfer tossed salad to salad bowls. Use both hands and start from top to bottom, left to right.

## APPENDIX B





## APPENDIX C

COMMENT SHEET  
SALAD WORK TABLE

Arrangement No. \_\_\_\_\_ Date \_\_\_\_\_  
Subject No. \_\_\_\_\_ Age \_\_\_\_\_  
Height \_\_\_\_\_ Temp. \_\_\_\_\_

Please write your comments or suggestions on the spaces provided after each question. Any comments or suggestions to improve the salad work table will be appreciated.

1. What do you feel about the arrangement of articles in the drawers or panels? (Is it well arranged?) (Check)

Yes \_\_\_\_\_

No \_\_\_\_\_

2. Should some articles be located elsewhere? (Check and comment .

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, where? (Indicate equipment and location suggested).

3. Are the articles (Please check after each question .

A easy to locate? Yes \_\_\_\_\_ No \_\_\_\_\_

B easy to reach? Yes \_\_\_\_\_ No \_\_\_\_\_

C easy to take out? Yes \_\_\_\_\_ No \_\_\_\_\_

4. What do you think of the height of storage area or drawers? (Check).

Just right \_\_\_\_\_ For Some \_\_\_\_\_ All \_\_\_\_\_

Too low \_\_\_\_\_ For Some \_\_\_\_\_ All \_\_\_\_\_

Are there any drawers or storage area that are located too low?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, which one?

5. Is there sufficient or enough space provided between articles within the drawers or panels?

Yes \_\_\_\_\_

No \_\_\_\_\_

If no, which one? (list articles).

6. Is there enough space allowance between drawers to permit easy handling of articles? (Check if you agree).

Yes \_\_\_\_\_

Or should the spaces between drawers or panels be spaced farther apart? (Check if you agree).

Yes \_\_\_\_\_

7. What did you especially like about the arrangement?

8. What did you especially dislike about the arrangement?

COMMENT SHEET  
SALAD WORK TABLE

Subject no. \_\_\_\_\_

Date \_\_\_\_\_

1. After working on the two different arrangements of a salad work table, which arrangement do you prefer? (Please check .

First Arrangement (A) \_\_\_\_\_

Second Arrangement (B) \_\_\_\_\_

2. Which flow of work do you prefer? (check below .

Right to left \_\_\_\_\_

Left to right \_\_\_\_\_

3. Did the flow of work in the two arrangements bother you at all?

Yes \_\_\_\_\_

No \_\_\_\_\_

4. Do you have any suggestions or comments?

STORAGE ARRANGEMENT FOR A SALAD WORK TABLE

by

GUIA RUTOR MARTINEZ

B. S., University of Santo Tomas, Philippines, 1962

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Institutional Management

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1968

The purpose of this research was to determine two ways of locating and organizing the storage space for a salad work table to be used by one employee for a 200-250 student dining hall.

The focus of the study was on: design of a salad work table and two types of storage facilities for small equipment; formulation of a basic utensil list; and standardization of procedure for making three types of salads. The inventory of equipment was stored, according to the principles of motion economy, in the two storage facilities: conventional drawer type (arrangement A) and vertical panel type (arrangement B).

Two criteria were used to evaluate the organization of equipment in the two arrangements: physiological cost as measured by extra heartbeats during work, and length of reach from the table top. The two arrangements developed were compared by length of reach with one in actual use in a residence hall serving 200-250 students.

Twelve female students of the College of Home Economics, Kansas State University were used as subjects. The activity consisted of preparing three salads for each arrangement following the determined standardized procedure. An opinionnaire survey was used to obtain subjects' reactions to the organization of equipment in the two arrangements and to determine their preference.

Treatment of data with the Wilcoxon-Matched-Pair-Signed

tests showed little effect among salads. Total average extra heartbeats for each subject were 22.61 for arrangement A and 20.42 for B. Comparison of average extra heartbeats for arrangement A and B showed no significant difference in physiological cost.

Total length of reach for arrangement A was 4 ft., for arrangement B, 3 ft., and for the residence hall arrangement, 14 ft.

In general, results of the study showed no significant difference between the two arrangements in physiological cost and length of reach but 10 of the 12 subjects preferred arrangement B to A.